

reasons. In the prior art the reaction chamber is heated by the electric furnace, generating a magnetic field. In contrast with the prior art, in the present invention the voltage is applied to the surface of the substrate coated with a powdered metallic catalyst only to keep the catalyst negatively charged and to form a static electric field around the substrate. The minimal magnetic field could be generated by the electric current in the connection wires during the time while the substrate is charging, but once the substrate is charged and the negative electric field is created, there is substantially no magnetic field present either inside or outside of the reaction chamber. Independent claim 19, from which claims 23, 24, and 36 depend, was amended to clarify that "the reaction chamber is substantially free of magnetic field during the heating" (emphasis added). Claim 35 depends from claim 26, and recites that "the heating device produces substantially no magnetic field in the reaction chamber." The cited prior art reference teaches inserting the reaction chamber in an electric furnace that continuously generates a magnetic field while heating the reaction chamber. The present invention does not teach, disclose or even suggest using a heating device that would generate a magnetic field during the time of the reaction. (See, e.g. page 5, lines 16-29 of Specification, in reference to the Figure 1). For these reasons the magnetic field during the reaction time would be either substantially absent or minimal and, therefore, claims 23, 24, 35, and 36 do not contradict the substantially magnetic-free requirement and are allowable.

Claims 19, 21, 22, 26, 27, 29, 31 and 34 were amended to address the concerns of the Examiner. It is respectfully submitted that all claims now fully comply with 35 U.S.C. § 112, and, therefore, it is respectfully requested that the rejection be withdrawn.

With regard to claims 19-22 and 25-34 being rejected under 35 U.S.C. §103(a) as being unpatentable over UK Patent Application No. 2,248,230, it is respectfully submitted that the reaction chamber of the present invention is heated by the hot air fed to the heating chamber 24 and therefore, the reaction chamber is not exposed to an electromagnetic field. Absence of an electromagnetic field surrounding the reaction chamber prevents deposition of linear carbon fibers, carbon powder, hard carbon agglomerates or carbon sheet and increases the yield of the carbon fiber coils that have a circular cross-section, small coil diameter and great coil length, as described in details on pages 15-16, lines 21-14.

The UK Patent No. 2,248,230 teaches inserting a reaction tube in an electric furnace that generates an electromagnetic field outside of the reaction tube, which in turn is responsible for

generating linear-shaped fibers, carbon in the form of particles, hard agglomerates and sheets. The electromagnetic field also causes generated carbon fiber coils to have an oblate cross section, large coil diameter and a small coil length, as described on pages 10, line 7 through page 12, line 22 of the UK Patent.

New independent claim 37 has been added. Claim 37 is directed to the method of manufacturing carbon fiber coils and is supported in Specification on pages 12-16, lines 14-25. For reasons similar to those discussed above, the cited prior art reference does not teach a method disclosed in the present invention, and, therefore, claim 37 is allowable.

Accordingly, it is respectfully submitted that the present invention is not obvious over the cited prior art reference, and, therefore, it is respectfully requested that the rejection be withdrawn.

CONCLUSION

Attached hereto is a marked-up version of the changes made to the claims by the current Amendment along with a complete set of claims provided for the Examiner's convenience. The attached pages are captioned "Marked-Up Version Of The Changes To The Claims" and "Claims Appendix."

In view of the foregoing, applicant submits that this application is now in condition for allowance. The issuance of a formal notification to that effect at an early date is requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,



Kevin T. LeMond
Reg. No. 35,933

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, 8th Floor
San Francisco, California 94111-3834
Tel: (415) 576-0200
Fax: (415) 576-0300
KTL:OV/jtc

MARKED-UP VERSION OF THE CHANGES TO THE CLAIMS

19. (Amended) A method of manufacturing carbon fiber coils comprising:
placing a solid catalyst **[at a predetermined position]** within a reaction chamber;
supplying stock gas and a catalytic gas to the reaction chamber;
heating the interior of the chamber to grow carbon fiber coils from the stock gas, wherein an exterior of the reaction chamber is substantially free of a magnetic field during the heating.
21. (Amended) The method according to claim 20 including supplying the stock gas and the catalytic gas to the reaction chamber at respective **[predetermined]** velocities through a port formed in the reaction chamber.
22. (Amended) The method of claim 21 including setting the position of the solid catalyst and the velocity of the stock gas, wherein the ratio of the velocity of the stock gas to [in the range of 10 to 1000 times] a distance between an outlet of the port and the solid catalyst is set in a range of 10 to 10000 [when the velocity is expressed in centimeters per minute and the distance is expressed in centimeters].
26. (Amended) An apparatus for manufacturing carbon fiber coils from a stock gas, which is subjected to thermal decomposition to generate solid carbon, and a catalytic gas, which promotes thermal decomposition of the stock gas, the apparatus comprising:
a reaction chamber, to which the stock gas and the catalytic gas are supplied through a port;
a solid catalyst located **[at a predetermined position]** within the reaction chamber;
and
a heating device for heating the interior of the reaction chamber to grow carbon fiber coils from the stock gas, wherein the heating device produces substantially no magnetic field in the reaction chamber.

27. (Amended) The apparatus according to claim 26, wherein the solid catalyst faces an outlet of the port and is spaced from the outlet by a distance, and the stock gas is supplied to the reaction chamber at a certain velocity, wherein the ratio of the velocity of the stock gas to [in the range of 10 to 1000 times] the distance [that] is in a range of 10 [1/10000] to 10000 [1/10 of the velocity of the stock gas flowing through the port when the velocity is expressed in centimeters per minute and the distance is expressed in centimeters].

29. (Amended) The apparatus according to claim 28, wherein the catalyst contains [**fine crystals**] microcrystalline of nickel.

31. (Amended) The apparatus of claim 30, wherein the catalytic gas contains at least one of sulfur compound and phosphorus compound, and the sulfur compound and phosphorus compound include [,] thiophene, hydrogen sulfide, methylmercaptan, [**phosphorus,**] and phosphorus trichloride.

34. (Amended) The apparatus according to claim 32, wherein the heating device includes a heating chamber surrounding the periphery of the reaction chamber, and a heated [high temperature] fluid is delivered to the heating chamber.

37. (New) A method of manufacturing carbon fiber coils comprising:
placing a solid catalyst within a reaction chamber;
supplying a stock gas and a catalytic gas to the reaction chamber, wherein the stock gas is supplied through the gas supplying port at a velocity, wherein the ratio of the velocity to the distance is set in a range of 10 to 10000;
applying a DC voltage to the solid catalyst to negatively charge the solid catalyst; and
heating the reaction chamber to a temperature in a range of 700 to 830 degrees Centigrade to grow carbon fiber coils from the stock gas using a heating device that generates substantially no magnetic field around the reaction chamber.

CLAIMS APPENDIX

19. (Amended) A method of manufacturing carbon fiber coils comprising:
placing a solid catalyst within a reaction chamber;
supplying stock gas and a catalytic gas to the reaction chamber;
heating the interior of the chamber to grow carbon fiber coils from the stock gas,
wherein an exterior of the reaction chamber is substantially free of a magnetic field during the heating.
20. The method of claim 19, wherein the catalytic gas contains elements of the fifteenth and sixteenth groups in the periodic table.
21. (Amended) The method according to claim 20 including supplying the stock gas and the catalytic gas to the reaction chamber at respective velocities through a port formed in the reaction chamber.
22. (Amended) The method of claim 21 including setting the position of the solid catalyst and the velocity of the stock gas, wherein the ratio of the velocity of the stock gas to a distance between an outlet of the port and the solid catalyst is set in a range of 10 to 10000.
23. The method according to claim 22 including applying voltage to the catalyst to charge the solid catalyst.
24. The method according to claim 23, wherein the voltage is a DC voltage and the solid catalyst is negatively charged.
25. The method according to claim 22, wherein the interior of the chamber is heated to a temperature in the range of 700 to 830 degrees Centigrade.

26. (Amended) An apparatus for manufacturing carbon fiber coils from a stock gas, which is subjected to thermal decomposition to generate solid carbon, and a catalytic gas, which promotes thermal decomposition of the stock gas, the apparatus comprising:

a reaction chamber, to which the stock gas and the catalytic gas are supplied through a port;

a solid catalyst located within the reaction chamber; and

a heating device for heating the interior of the reaction chamber to grow carbon fiber coils from the stock gas, wherein the heating device produces substantially no magnetic field in the reaction chamber.

27. (Amended) The apparatus according to claim 26, wherein the solid catalyst faces an outlet of the port and is spaced from the outlet by a distance, and the stock gas is supplied to the reaction chamber at a certain velocity, wherein the ratio of the velocity of the stock gas to the distance is in a range of 10 to 10000.

28. The apparatus according to claim 27, wherein the stock gas contains one of acetylene, methane, and propane.

29. (Amended) The apparatus according to claim 28, wherein the catalyst contains microcrystalline of nickel.

30. The apparatus of claim 27, wherein the catalytic gas contains a gas having elements of the fifteenth and sixteenth groups in the periodic table.

31. (Amended) The apparatus of claim 30, wherein the catalytic gas contains at least one of sulfur compound and phosphorus compound, and the sulfur compound and phosphorus compound include thiophene, hydrogen sulfide, methylmercaptan, and phosphorus trichloride.

32. The apparatus according to claim 26, wherein the reaction chamber is heated to a temperature in the range of 700 to 830 degrees Centigrade.

33. The apparatus according to claim 32, wherein the heating device includes a burner.

34. (Amended) The apparatus according to claim 32, wherein the heating device includes a heating chamber surrounding the periphery of the reaction chamber, and a heated fluid is delivered to the heating chamber.

35. The apparatus according to claim 26 further comprising a power source, which is external to the reaction chamber, for applying voltage to the solid catalyst.

36. The apparatus according to claim 35, wherein the power source is a DC power source for negatively charging the solid catalyst.

37. (New) A method of manufacturing carbon fiber coils comprising:
placing a solid catalyst within a reaction chamber;
supplying a stock gas and a catalytic gas to the reaction chamber, wherein the stock gas is supplied through the gas supplying port at a velocity, wherein the ratio of the velocity to the distance is set in a range of 10 to 10000;
applying a DC voltage to the solid catalyst to negatively charge the solid catalyst; and
heating the reaction chamber to a temperature in a range of 700 to 830 degrees Centigrade to grow carbon fiber coils from the stock gas using a heating device that generates substantially no magnetic field around the reaction chamber.